

Remarks / Arguments

Claims 1, 7, 9, 10, 12 and 14 are amended and claims 19-26 are newly added. Thus, claims 1-26 are pending upon entry of this amendment.

Support for amendments

Support for the amendments may be found throughout the specification and claims. Exemplary support is provided for each amendment.

The title is amended to recite "Process for the wet-chemical treatment of one side of silicon wafers." Support may be found in the preamble of claim 1, which includes, "A process for wet-chemical treatment of one side of silicon wafers using a liquid bath."

Claim 1 is amended to recite, A process for wet-chemical treatment of one side of silicon wafers using a liquid bath, during which treatment the silicon wafers lay on conveyor means and the entire surface of the underside to be treated is conveyed through or over liquid located in the liquid bath, wherein the conveyor means are positioned within the liquid bath, further wherein the top sides of the wafers which are not to be treated are always positioned above the liquid.

Support for the amendment may be found on page 10, line 1 through page 11, line 1, which provides in part,

"The use of a conveyor system for guiding the substrates which are to be treated as part of the process according to the invention in principle allows both active and passive wetting. In the case of active wetting, the substrate to be treated is guided through the liquid, whereas passive wetting is effected by correspondingly configured components of the conveyor system...

According to one embodiment of the present invention the substrates are laid on a conveyor system, such as for example a roller conveyor system... In the context of the active wetting as defined above, the individual conveyor rolls are preferably arranged in such a manner in a liquid bath that in each case the upper edge of the rolls is located

approximately at the level of the bath surface, i.e. of the upper edge of the liquid...

In this context, it is important that it be possible for the height of the liquid bath to be set so accurately with respect to the conveyor system that it is possible for the underside and if appropriate the edges of the substrates to be wetted without the top sides of the substrates also being wetted.”

Further support may be found at page 8, lines 32-38, which provides in part,

“By contrast, in the context of the invention passive or indirect wetting is to be understood as meaning that the underside of the substrate which is to be treated is above the level of the liquid...and consequently wetting is effected only indirectly by means of components of the system[.]”

Claim 7 is amended to correct spelling and to remove the language “such as for example.”

Claim 9 is amended to correct claim grammar or spelling.

Claim 10 is amended to recite, A process for wet-chemical treatment of one side of silicon wafers using a liquid bath, during which treatment the wafers lay on conveyor means and are conveyed with the underside to be treated through or over liquid located in the liquid bath, wherein the level of the liquid being contacted by the underside is maintained above the level of the bath surface not being contacted by the underside, further wherein the top sides of the wafers which are not to be treated are always positioned above the level of the liquid.

Support for the amendment may be found on pages 8, 10 and 11 as demonstrated above with respect to the amendments to claim 1. Still further support is provided at page 10, lines 26-32, which provide,

“In this case, a meniscus may form at the substrate edges. The interplay of gravity and surface tension then draws the substrate downward and ensures that it remains in contact with the rolls without floating. This allows controlled and defined conveying of the substrates using the roll conveyor system.”

Claim 12 is amended to correct antecedent basis in view of the amended claims.

Claim 14 is amended and claim 19 is newly added, to recite the conveyor means are provided in the form of belts or conveyor rolls. Support may be found at page 16, lines 11-15, which provides,

“It should also be noted that it is possible to use alternative embodiments of conveyor systems which do not employ conveyor rolls. By way of example, substrates can also be conveyed on a rotating belt, a chain or also cords.”

Claims 20 and 23 are newly added and recite that the treatment is an etching, coating or cleaning step. Support may be found at page 5, lines 3-5, which provides, “A treatment of one side in this manner comprises, for example, an etching, coating or cleaning of one of the two surfaces.”

Claims 21 and 26 are newly added and recite that the top sides of the wafers are not protected during treatment. Support may be found at page 4, lines 30-36, which provide in part,

“Therefore, the object of the present invention is to provide a process for treating one side of silicon wafers in which it is possible to make do without the process steps of the prior art involving protecting or masking the front surfaces or top sides which are not to be treated, yet the process can preferably be carried out in a production line.”

Claim 22 is newly added and recites the silicon wafers are processed continuously in a once-through process. Support may be found in claim 2.

Claim 23 is newly added and provides that the etching is carried out in a liquid composition which contains NaOH, KOH, HF, HNO₃, HF with O₃, and/or HF with oxidizing agent. Support may be found in claim 7.

Claim 24 is newly added and provides that the oxidizing agent is an oxidizing acid. Support may be found in claim 8.

Introduction to the Invention

The present invention provides methods for treating one side of silicon wafers. Compared to previous methods, the present methods drastically reduce the handling steps involved, which further reduces the risk of breakage of the usually thin and fragile silicon wafers. This is accomplished in part by developing a process that permits wafers to lay on a conveyor means and be conveyed through or over liquid in a controlled manner, which is only possible when wafers do not float away from the means. In this regard, it was surprising to learn that the wafer during treatment can be conveyed through the liquid in a controlled and targeted manner without floating apart from their predetermined path.

Response to Objections to the Specification

A. Objections to the title

The examiner has objected to the title as not being sufficiently descriptive of the pending claims. Applicant has amended the title to correspond to the preamble of the pending claims. Accordingly, applicant respectfully requests the objection be withdrawn.

B. Objections referencing “Figure 1”

The examiner acknowledges the specification refers to Figure 1; however, Figure 1 was not provided with the 371 national phase entry documents. Provided herewith is Figure 1 as provided in the international application. As such, the specification correctly refers to Figure 1. Accordingly, applicant respectfully requests the objection be withdrawn.

Response to Objections to the Drawings

The examiner indicates that the subject matter of the application admits of illustration by a drawing to facilitate understanding of the invention. The examiner requires applicant furnish a drawing under 37 CFR 1.81(c).

Provided herewith is a new sheet of drawings depicting Figure 1. Figure 1 is provided from international application PCT/DE2004/000597, from which this application is the US national phase. PCT/DE2004/000597 published as WO 05/093788.

For completeness, PCT/DE2004/000597 was incorporated by reference in its entirety at page 1 of the specification.

Accordingly, applicant respectfully requests the rejection be withdrawn.

Response to Claim Rejections 35 U.S.C. § 112 (Indefinite)

Claims 1-9 are rejected as being indefinite under 35 U.S.C. §112, second paragraph, due to typographical errors in spelling and for using the term “such as for example” in claim 7.

The definiteness of language employed must be analyzed not in a vacuum, but in light of the teachings of the prior art and of the particular application disclosure as it would be interpreted by one possessing ordinary skill in the art. Allen Archery Inc. v. Browning Mfg. Co., 2 USPQ2d 1490, 1494 (Fed. Cir. 1987). “If the claims, read in light of the specification, reasonably apprise those skilled in the art both of the utilization and scope of the invention, and if the language is as precise as the subject matter permits, the courts can demand no more.” North Am. Vaccine, Inc. v. American Cyanimid Co., 28 USPQ2d 1333, 1339 (Fed. Cir. 1993). Applicant provides the follow amendments to clarify the scope of the claims.

Claim 1 is amended to correct the spelling of “underside”;

Claim 1 is amended to delete the misspelling of “protected”;

Claim 7 is amended to correct the spelling of “NaOH”; and

Claim 7 is amended to remove the term “such as for example”.

As such, applicants respectfully request the rejections be withdrawn and the claims allowed.

Response to Claim Rejections Under 35 U.S.C. § 102 (Anticipation)

A. Standard for Anticipation

Anticipation requires a single prior art reference disclose each and every element of the claim under consideration.” W.L. Gore & Assocs. V. Garlock, Inc., 220 USPQ 303, 313 (Fed. Cir.1983). However, it is not enough that the reference discloses all of the claimed elements in isolation. Rather, as stated by the Federal Circuit, the prior art reference must disclose each and every element of the claimed invention “arranged as in the claim.” Lindemann Maschinenfabrik GMBH v. American Hoist & Derrick Co., 730 F.2d 1452, 221 USPQ 481, 485 (Fed. Cir.1984). Further, the prior art must be such that a person of ordinary skill in the art would consider there to be no difference between the claimed invention and the referenced disclosure. In re Gurley, 27 F.3d 551, 31 USPQ2d 1130, 1132 (Fed Cir. 1994).

B. Claims 1-6, 10-15 and 17 Are Not Anticipated By Hiraishi et al. (US 6,506,260)

The examiner rejects claims 1-6, 10-15 and 17 under 35 U.S.C. §102(b) as being anticipated by Hiraishi et al. Specifically, the examiner argues Hiraishi et al. teach treating one side of silicon wafers in a liquid bath, characterized in that the underside of the silicon wafers are treated without the top side previously having been protected or masked. The examiner cites col. 1, ll. 19-23 and 62-63, FIG. 1 and its description in the specification as support.

Claims 1 and 10 are amended to clarify that the top sides of the wafers which are not to be treated are always positioned above the liquid. Hiraishi et al. do not teach this element.

Hiraishi et al. provide a method for cleaning a photovoltaic module, which includes a laminate. In Hirashi et al. the photovoltaic module is entirely immersed in the cleaning fluid for the removal of particles from grooves from the top side of the laminate. This is summarized in the abstract,

“The cleaning method includes a process for transporting the photovoltaic module immersed in a cleaning fluid, while being kept in a horizontal position with the laminate upward as it is transported, and applying ultrasonic vibration to the cleaning fluid, thereby removing particles in the scribed grooves.”

This is further evident viewing FIG. 1. FIG. 1 depicts the photovoltaic module (1) which includes the laminate (L) facing upwards and being entirely immersed in the cleaning fluid (W).

Thus, whereas claims 1, 10 and claims that depend therefrom provide the top sides of the wafers which are not to be treated are always positioned above the liquid; Haraishi et al. treat the top, laminate side of the photovoltaic module by immersing the entire module in the cleaning fluid. In Haraishi et al. both the top and underside are kept under the fluid at all time. Since Hiraishi et al. do not teach each element as arranged in the claims; Hiraishi et al. do not anticipate the present invention. Accordingly, applicant respectfully requests the rejections be withdrawn and the claims allowed.

C. Claims 1-3 Are Not Anticipated by Doolittle et al. (US 6,015,462)

The examiner rejects claims 1-3 under 35 U.S.C. §102(b) as allegedly being anticipated by Doolittle et al. Specifically, the examiner argues Doolittle et al. teach treating one side of silicon wafers in a liquid bath, characterized in that the underside of the silicon wafers is treated in the liquid bath without the top side previously having been protected or masked.

Claim 1 is amended to clarify that the silicon wafers lay on conveyor means and the entire surface of the underside to be treated is conveyed through or over the liquid located in the bath. Further, in claim 1 the conveyor means are positioned within the liquid bath. Doolittle et al. do not teach these elements.

In Doolittle et al. a process head includes holding fingers for holding a semiconductor wafer. Thus, in Doolittle et al. the semiconductor is held from above and does not lay on conveyor means. Further, Doolittle et al. do not position a conveyor means within the bath. A vertical drive motor vertically lowers the process head to lower the semiconductor wafer into a bowl that contains a process solution or fluid. Thus, in Doolittle et al. the semiconductor wafer is lowered into and raised upward from the solution. The process head with holding fingers is disclosed at col. 2, lines 42-48, which provides,

“The semiconductor workpiece holder (12) of module (10) is configured to support a semiconductor workpiece (W), such as a semiconductor wafer. The semiconductor wafer (W) has a first or lower surface (S_1) and a second or upper surface (S_2). Workpiece holder (12) includes a process head (16). Process head (16) includes fingers or holders (18) coupled with a lower surface (20) thereof. Fingers (18) of holder (12) are configured to support a semiconductor workpiece (W) adjacent a lower surface (20) of head (16).

Vertically transporting the semiconductor wafer into the liquid bath is provided at col. 2, line 66 through col. 3, line 6, which provides,

“Movement of vertical shaft (24) in either an upward or downward direction provides corresponding movement of head (16) upward or downward with respect to process bowl (14). In particular, vertical drive motor (22) is configured to lower head (16) to a sufficient position to bring semiconductor workpiece (W) in contact with process solution or fluid (38) within process bowl (14). Typically, the process fluid (38) is a liquid.”

Thus, whereas in claim 1, the silicon wafers lay on a conveyor means, the entire surface of the underside to be treated is conveyed through or over the liquid located in the bath, and conveyor means is positioned within the liquid bath; Doolittle et al. provide a set of holding fingers to hold the wafer from above and a vertical drive motor to lower the semiconductor wafer into the solution and raise the semiconductor from the solution. Further, Doolittle et al. do not position a conveyor means in the bath. Accordingly, Doolittle et al. do not teach each element as arranged in the claims. Thus, applicants respectfully request the rejection be withdrawn and the claims allowed.

**D. Claims 1-4, 6, 7, 10-12, 14, 15 and 17 Are Not Anticipated by Wandel et al.
(US 6,306,224)**

The examiner rejects claims 1-4, 6, 7, 10-12, 14, 15 and 17 under 35 U.S.C. §102(b) as allegedly being anticipated by Wandel et al. Specifically, the examiner argues Wandel et al. teach treating one side of silicon wafers in a liquid bath, characterized in that the underside of the silicon wafers is treated in the liquid bath without the top side previously having been protected or masked.

Claims 1 and 10 are amended to clarify that the silicon wafers lay on conveyor means, the surface of the underside to be treated is conveyed through or over liquid located in the bath; and the top sides of the wafers which are not to be treated are always positioned above the liquid. Wandel et al. do not teach these elements.

In Wandel et al. fragile thin sheets are disposed in radial slots of a rotating disk. The disk rotates vertically through a liquid bath to entirely immerse the thin sheets in liquid. This is summarized in the abstract, which states,

“A process and device for treating sheet objects, especially fragile sheet objects, by rotation through a liquid bath. The objects are disposed in radial slots in a rotating disk, retained therein by a flexible element moving synchronously with the disk, and by a retaining element mounted adjacent the disk and spaced therefrom along its axis of rotation.”

The use of a rotating disk to immerse the thin sheets in liquid is also provided at col. 4, lines 54-56, which refers to FIG. 1,

“FIG. 1 shows a principle view of a conveying device (10) using which objects (12) are to be conveyed through the bath (16) containing a fluid, in order to etch surfaces, for example.”

These features are further evident viewing FIG. 1. FIG. 1 depicts a rotating disk (30) with radial aligned slots (38, 40) for insertion of objects (12), which when rotated are entirely immersed in the fluid (14) of the bath (16).

Thus, whereas in claim 1 and 10 the silicon wafers lay on conveyor means, the surface of the underside to be treated is conveyed through or over the liquid located in the bath, and the top sides of the wafers which are not to be treated are always positioned above the liquid; Wandel et al. provide a vertically rotating disk with radial slots to rotate

thin sheets through a liquid bath to entirely immerse the thin sheets in liquid. Accordingly, Wandel et al. do not teach each element as arranged in the claims. Thus, applicant respectfully requests the rejection be withdrawn and the claims allowed.

Response to Claim Rejections Under 35 U.S.C. §103 (Obviousness)

A. Standard for Obviousness

A proper obviousness rejection requires consideration of the factual inquiries provided in Graham v. John Deere Co., 38 U.S. 1, 148 USPQ 459 (1966), including: 1) determining the scope and contents of the prior art; 2) ascertaining the differences between the prior art and the claims at issue; 3) resolving the level of ordinary skill in the pertinent art; and 4) considering the objective evidence present in the application indicating obviousness or nonobviousness. Importantly, the differences between the cited references and the claim must be obvious in view of one skilled in the art.

When combining references, it is important to consider the reference as a whole. In Bausch & Lomb, Inc. v. Barnes-Hind/Hydrocurve, Inc., 796 F.2d 443, 230 USPQ 416 (Fed. Cir. 1986), cert. denied, 484 U.S. 823 (1987), the Federal Circuit held that a single line in a prior art reference should not be taken out of context and relied upon with the benefit of hindsight to show obviousness; but instead a reference should be considered as a whole, and portions arguing against or teaching away from the claimed invention must be considered. In addition, an obviousness rejection is not appropriate if substantial reconstruction or redesign of the prior art reference is necessary to arrive at the invention. In re Ratti, 123 USPQ 349 (C.C.P.A. 1959).

B. Claims 7-9, 16 and 18 are Not Obvious Over Hiraishi et al (US 6,506,260)

The examiner rejects claims 7-9, 16 and 18 under 35 U.S.C. §103(a) as allegedly being obvious over Hiraishi et al. The examiner restates the rejection as set forth against

claims 1 and 10 and argues the above claims differ from the prior art by specifying well-known features to the art of wet cleaning and etching. Thus, the examiner concludes that a person having ordinary skill in the art would have found it obvious to modify the prior art by adding any of the same well known features in order to provide efficient cleaning or etching with a reasonable expectation of success.

Claims 7-9 depend from claim 1 and claims 16 and 18 depend from claim 10. Applicant herein incorporates by reference the arguments set forth above with respect to the anticipation rejection over Hiraishi et al. Specifically, Hiraishi et al. provide a method for cleaning a photovoltaic module, which includes a laminate. In Hiraishi et al. the photovoltaic module is entirely immersed in the cleaning fluid for removing particles from grooves from the top side of the laminate.

As demonstrated above, Hiraishi et al. do not teach the each element of claims 1 or 10. For instance, Hiraishi et al. do not teach the top sides of the wafers which are not to be treated are always positioned above the liquid. Thus, neither claim 1 nor 10 is anticipated or obvious over Hiraishi et al. Since neither claim 1 nor 10 is obvious over Hiraishi et al. claims 7-9, 15 and 18, which depend therefrom, are not obvious over Hiraishi et al.

Accordingly, applicant respectfully requests the rejections be withdrawn and the claims allowed.

C. Claims 5, 8, 9, 13, 16 and 18 Are Not Obvious Over Wandel et al. (US 6,306,224)

The examiner rejects claims 5, 8, 9, 13, 16 and 18 under 35 U.S.C. § 103(a) as allegedly being obvious over Wandel et al. Specifically, the examiner restates the rejection as set forth in the anticipation rejection over Wandel et al. and adds that the present claims differ from the prior art by specifying well known features to the art of wet cleaning and etching. Accordingly, the examiner argues that a person having ordinary skill in the art would have found it obvious to modify the prior art by adding any of the same well-known features in order to provide efficient cleaning or etching with a reasonable expectation of success.

Claims 5, 8 and 9 depend from claim 1 and claims 13, 16 and 18 depend from claim 10. Applicant herein incorporates by reference the arguments set forth above with respect to the anticipation rejection over Wandel et al. Specifically, in Wandel et al. fragile thin sheets are disposed in radial slots of a rotating disk, which vertically rotates through a liquid bath to entirely immerse the thin sheets in liquid.

As demonstrated above, Wandel et al. do not teach the each element of claims 1 or 10. For instance, Wandel et al. do not teach the silicon wafers lay on conveyor means, the surface of the underside to be treated is conveyed through or over the liquid located in the bath; and the top sides of the wafers which are not to be treated are always positioned above the liquid. Thus, neither claim 1 nor 10 is anticipated or obvious over Wandel et al. Since neither claim 1 nor 10 is obvious over Wandel et al. claims 5, 8, 9, 13, 16 and 18, which depend therefrom, are not obvious over Wandel et al.

Accordingly, applicant respectfully requests the rejections be withdrawn and the claims allowed.

Conclusion

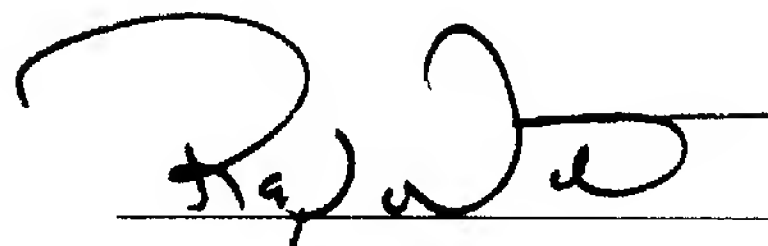
In view of the amendments and arguments set forth above, applicant respectfully requests the withdrawal of all rejections and a notice of allowance be issued for the present application.

Respectfully submitted,

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Date

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